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A MODULAR THREE PHASE AC VOLTAGE CONTROLLER FOR INDUCTION MOTOR

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ABSTRACT

Three phase induction motor (IM) is widely used in the industries because in rugged construction. User needs to control speed of the motor depending on the desired speed and application. In this paper launched the speed control of 3-phase IM is controlled by 3-phase AC voltage controller by varying the voltage by PWM technique. In olden days speed control was possible for DC motors only, but with the presence of power electronics converters such as AC regulators, Inverters and cycloconverters are used to control the speed of induction motors. These days regulating the stator source voltage at a constant frequency is one of the modern and low cost methods in order to control the speed of induction motors near its nominal speed. The speed control of IM by 3-phase inverters, cycloconverters require forced commutation circuit, which is complicated and these presents high surge currents and surge voltages. But AC voltage controller makes use of line commutation and as such no complex commutation circuitry is required in this controller. The main application of this model is fan drives, domestic pump and industrial applications.

KEYWORDS: Induction Motor, Alternating Current, Direct Current, Pulse Width Modulation

INTRODUCTION

The IM have more advantages over the rest of motors. The main benefit is that IM do not require an electrical connection between the stationary and the rotating parts of the motor. Therefore they don't want any mechanical Commutator, foremost to the fact that they are maintenance free motors. Besides, induction motors also have low weight and inaction, high proficiency and a high excess capability. Therefore they are inexpensive and more robust, and less proves to any disaster at high speeds. Moreover, the motor can work in explosive environments because no sparks are produced. Taking into account all of the advantages outlined above, the IM must be considered as the perfect electrical to mechanical energy converter. Still, mechanical energy is more than often required at variable speeds, where the speed regulating system is not an insignificant matter. Thus the IM is considered to be the work horse of production. The advancement of power electronics had made it possible to vary the voltage or frequency supplies relatively easy using various control techniques and thus has extended the use of induction motor in variable drive applications.

In industries, there are two basic needs for the development of the power electronic devices. The needs are high efficiency and a control voltage. AC voltage controller makes use of line commutation and as such no complex commutation circuitry is required in this controller. In this paper stator voltage control method is used which offers limited speed drives. By changing the firing angle of TRIAC in each phase, the output voltage of the circuit fed to the stator of a SQIM is controlled [1].

The 3-phase induction motor is driven by the FSTPI method. PIC microcontroller 16f877A is used to produce the controlled PWM pulse for FSTPI method. The controlled PWM pulses of microcontroller are fed to the gate of MOSFETs of FSTPI through the driver circuit to drive the IM. The microcontroller has been programmed to vary the frequency of the

PWM signal that controls the frequency of the voltage applied at the gate drives and the result of this the switching frequency of the inverter is regulated [2].

The speed control of the induction motor was carried by the supply voltage is varied without frequency adjustment; the induction motor can operate in the flux saturation region or with a weakened field. The device was responsible for measuring the three-phase IM shaft angular speed with an optical encoder, reaching the fuzzy-control algorithm and lastly producing the sinusoidal-modulated PWM signal in order to turn on six insulated-gate bipolar transistors (IGBTs) of a three phase inverter [3].

The torque of induction motor is a nonlinear function of the firing angle and phase angle. The voltage of the stator can be symmetrically controlled between zero and its maximum value by controlling the firing angle of thyristors[7].

NEED OF INDUCTION MOTOR SPEED CONTROL

The Induction machine is very practical in many applications. The most used motor in industry because of its high robustness, low cost, high efficiency and good self-starting skill**.** To improve reliability of production in industries and other applications variable speed is required. The presence of power electronics converters such as Inverters and cycloconverters the speed control is also possible for induction motors. Usually in the past speed of the 3-phase induction motor was controlled by using 3-phase variac etc. Here selecting 3-phase AC voltage controller for the speed control of IM, AC controllers are thyristor - based devices, which transform permanent alternating voltage without a change in the frequency. By changing the firing angle of thyristor the output voltage of AC voltage controller

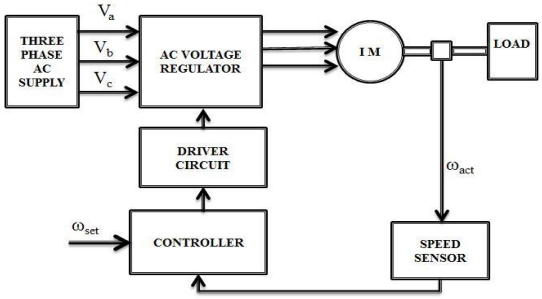

Figure 1: Block Diagram

AC VOLTAGE REGULATOR

AC voltage regulator is working to vary the RMS value of the alternating voltage supplied to a load circuit by presenting Thyristors among the load and ac voltage source. By controlling the firing angle of the thyristors in the ac voltage regulator circuits the RMS value of alternating voltage applied to a load circuit is controlled.

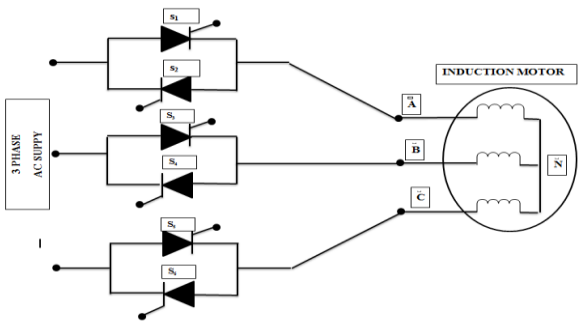

Figure 2: Circuit Diagram of AC Voltage Controller

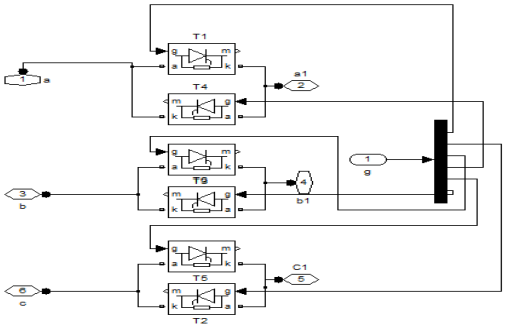

Figure 3: Simulation Diagram of AC Voltage Controller

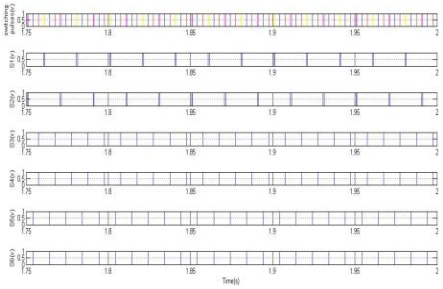

Figure 4: Gating Pulses of 6- Thyristors

SIMULATIONS AND RESULTS

The speed and torque waveform of induction motor under different pulses are shown here, this shows the proposed system works better than conventional methods.

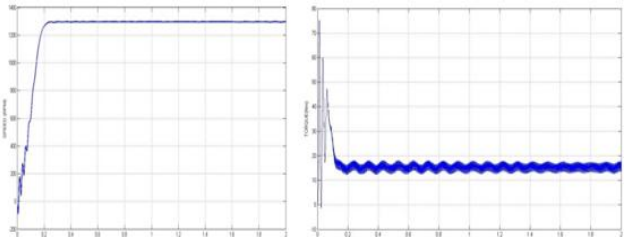

Figure 5: Speed and Torque at 1400 rpm

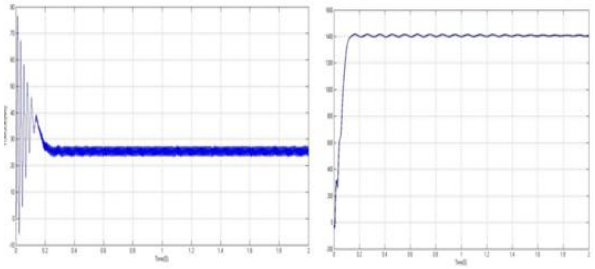

Figure 6: Speed and Torque at 1300rpm

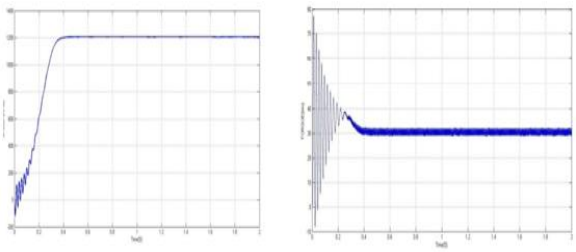

Figure 7: Speed and Torque at 1200 rpm

CONCLUSIONS

The new modular based three phase AC voltage controller for speed control of induction motor was proposed. In classical topology, speed control of induction motor by three phase inverter requires forced commutation which is complicated. The above drawback can be overcome by using AC voltage regulator. The proposed system is used for speed control of induction motor by AC voltage controller was simulated using MATLAB2010a version.

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APPENDICES

Table 1

Motor Specifications	Rating
Power rating	5.4 HP
Rated speed	1440 rpm
Max. Voltage	400 volt
Frequency	50 Hz
Stator resistance	1.405Ω
Rotor resistance	1.395 Ω
Mutual inductance	0.1722H
Stator inductance	0.005829H
Rotor inductance	0.005839H
Number of poles	4